

Article

The Function of Transition Brokers in the Regional Governance of Implementing Circular Economy—A Comparative Case Study of Six Dutch Regions

Jacqueline M. Cramer

Copernicus Institute of Sustainable Development, Utrecht University, Princetonlaan 8a, 3584 CB Utrecht, The Netherlands; j.m.cramer@uu.nl

Received: 31 May 2020; Accepted: 15 June 2020; Published: 19 June 2020



Abstract: This paper addresses the question of which function systemic intermediaries (here called ‘transition brokers’) can fulfil in the regional governance of implementing a circular economy (CE). Empirical research on this issue is scarce. The conclusion, based on a comparative case study of six Dutch regions, is that transition brokers fulfil the function of system orchestration. They can enhance processes of change, build alliances, help create the necessary preconditions, and develop impactful circular initiatives from a neutral standpoint. In a multi-stakeholder setting, transition brokers fulfil a variety of roles, depending on time period, content, and context. Executing these roles requires a number of specific competencies, varying from being entrepreneurially minded to daring to leave one’s comfort zone and being able to get the idea of CE accepted in a variety of businesses and organisations. From interviews held with key transition brokers in the six regions, it transpired that there is a clear division of labour between transition brokers vis-à-vis other key actors, among which the local government is included. These findings allow the design of a new model of regional governance in implementing CE from a system level perspective. It is recommended to perform similar case studies in other countries to generalise the results presented here.

Keywords: circular economy; transition management; technological innovation system; regional governance; systemic intermediary; transition broker; competencies; Dutch regions

1. Introduction

In the last decade, the circular economy (CE) has received increasing attention worldwide. It is seen as a way to overcome the current production-and-consumption model that is based on continuous growth and increasing resource throughput, resulting in environmental degradation and over-exploitation of natural resources [1,2]. CE aims to make this linear take–make–dispose pattern of production and consumption redundant, proposing a circular system in which the value of products, materials, and resources is maintained within the economy as long as possible [3]. The concept of CE has a long tradition [4]. A pivotal point came with the Spaceship Earth analogy by Kenneth Boulding [5]. Boulding called for a closed economy of the future, in which the Earth is seen as a single spaceship, without unlimited reservoirs of anything, either for extraction or for pollution, and in which, therefore, humankind must find its place in a cyclical ecological system. It was Ready-Mulvey and Stahel [6] who further developed Boulding’s view of a closed-loop economy [7]. Since then, comparable views have been formulated, focussing on, among others, industrial ecology [8] and industrial symbiosis [9].

The above views form the background of the contemporary understanding of CE and its practical applications to economic systems and industrial processes [10]. While the term CE is increasingly gaining traction within academia, industry, and policymaking, the similarities and differences between this concept and related concepts such as sustainability remain ambiguous [10]. According to

Geissdoerfer et al. [10], both concepts are essentially global in their nature, sharing concerns about how the current state of technology, industrial production, and consumption might jeopardise both future generations and present sources of unexplored competitive advantage. They also stress the importance of better integrating environmental and social aspects with economic progress and position system-level changes at their very core. Apart from these similarities, the concepts are notably used in different contexts and with different purposes, as Geissdoerfer et al. argue. Sustainability is more open-ended and includes a multitude of goals, depending on the considered agent and her interests. CE focuses on the particular goal of moving from a linear to a circular economy, ideally eliminating all resource input and leakage out of the system.

In defining CE, two material cycles are distinguished: the biological and the technical cycle [11,12]. Biological materials are those materials that can—if carefully managed—be safely returned to the biosphere, either directly or in a succession of consecutive uses. Technical materials, such as metals, plastics, and synthetic chemicals, are unsuitable for the biosphere and must continuously cycle through the system so that their value can be captured and recaptured [12]. This implies that industry must maximise profits through the reuse of components and goods, instead of the old approach of minimising the cost of recycling and disposal of goods. This can be achieved through ‘design to re-design’ thinking, aimed at long-lasting design, as well as maximising the potential for reusing products and recovering materials [7,13]. Stahel describes this as the service economy [14], which includes strategies of ‘retained ownership’ (operational leasing, renting, selling results instead of goods) [14] and prolonging the service life of products [15]. To guarantee the return of goods after each cycle, manufacturers are encouraged to adopt circular business models [16–18].

Much has been published about CE over the past decade [1,3,8,19]. Relying on an extensive literature survey and real cases, Winans et al. [8] emphasise that the governance of CE is an interplay between government, industry, and the community. National governments can enhance CE through clear short- and long-term objectives and policy instruments, such as subsidies, tax incentives, and regulatory instruments. However, without support from industry and the community, CE initiatives are not sustained, particularly in Western democracies [8,20]. While national governments have paid growing attention to the importance of moving to a CE system, the actual implementation in cities and regions is still in the early stages [1]. Therefore, research on how to implement CE locally is still scarce [1,19,21]. Local government strongly depends on the industry’s willingness to innovate if a transition to CE is to be successful [22]. How to tackle this challenge is hardly addressed in the literature [23]. In particular established companies (‘regime actors’) are often reluctant to take the lead in CE. They encounter organisational inertia and external challenges to developing new strategic networks around CE and replacing existing trusting relationships [18]. Newcomers in the market (‘niche’ actors) with ambitious CE objectives can develop circular innovations but often lack the support to scale up these innovations [24,25]. Due to these market constraints, Fischer and Newig [22] consider intermediaries to be potentially highly influential actors that can fulfil a mediating role. They can connect niche-level activities with regime level institutions and vice-versa and also spread new technologies and practices at a regional and even higher level [22].

While the function of intermediaries has been extensively researched in innovation literature [26], it has only recently been studied in sustainability transitions [27]. Contrary to conventional innovation focused on the company level, innovation oriented toward a sustainability transition concerns complex changes at system level. This implies that individual companies need to cooperate over the whole supply chain [1] and in networks with external partners (e.g., local government) [26]. To assist market actors in creating sustainability-oriented innovation and expand CE ambition, intermediaries can act as agents or brokers between two or more parties [28]. Empirical studies on their function in sustainability transitions, such as CE, are sporadic [22,26,28], and hardly any of them focus on the function of intermediaries vis-à-vis market actors and the overall governance at the city and regional level. More insight in their function can improve our understanding of how intermediaries can empower market actors, particularly newcomers, by encouraging widespread uptake of their circular

innovation, thereby helping to create the system change required for the CE transition. This is relevant for both scholars and practitioners. For scholars, it will bridge the knowledge gap on how the system-level implementation of the CE transition can be orchestrated locally. For practitioners, it will provide concrete suggestions of how to effectively organise the governance of the CE transition in practice and divide roles and responsibilities among the stakeholders, including the intermediaries.

Therefore, the research questions addressed in this paper are as follows: Which governance gap can intermediaries bridge by supporting market actors, particularly newcomers to implement CE at regional level? Which function do they fulfil complementary to local government and other parties? What does this imply in terms of the system-building activities and roles being performed by intermediaries vis-à-vis the other key actors and which competences do intermediaries need? To answer these questions, use is made of innovation science, particularly the transition management [29] and the technological innovation systems (TIS) approaches [30].

The analysis is based on experiences in the Netherlands, one of the leaders in CE within Europe [31]. As early as the early 1980s, the country implemented waste management and recycling programmes, while policies on eco-design of products followed in the 1990s [32]. Since then, a large network of companies and research institutes has gained experience with aspects of CE. Combining these initiatives into a broader CE approach was a challenging but plausible next step for government and industry [31]. In line with the EU's CE action plan of 2015, the Dutch government issued the government-wide CE programme [33], followed by an implementation programme [34]. The national CE policies stipulate that regions and cities have to set up their own CE programmes. These programmes often involve intermediaries (here called 'transition brokers'). These are persons that orchestrate the process of establishing circular initiatives at system level (here: in the region) in cooperation with relevant actors (e.g., industry, local governments, research and educational institutes and civil society). Such initiatives can focus on citizens' participation [35] or new business development [26]. The analysis presented here will focus on the function of transition brokers in building new, circular business in six Dutch regions.

First, a conceptual design of the regional governance in implementing the CE will be developed, based on the theoretical approaches to transition management and TIS. In particular the literature on actors and agency will be further explored, including the function of intermediaries in sustainability transitions. Second, the selection of the case study of six Dutch regional CE initiatives will be explained, as well as the methodology applied. To structure the fieldwork, a pilot study on transition brokers was first performed in the Amsterdam Metropolitan Area. Third, the empirical results of the Dutch case study will be presented in terms of the system-building activities performed and roles played by the transition brokers. Moreover, the function of transition brokers vis-à-vis the other key actors, particularly local government, within the overall regional governance in implementing CE will be summarised. Fourthly, based on the empirical findings, the conceptual design developed as theoretical framework will be further elaborated into a model of regional governance in implementing CE, which also specifies the system-building activities performed by the key actors. Finally, conclusions will be drawn, and recommendations will be formulated for scholars and practitioners.

2. Theoretical Perspective

The literature on transition management is useful for conceptualising how the transition to CE can be implemented in a local context. This stream of literature builds on innovation science but adds the perspective of deliberately influencing change processes [29]. Since the turn of the century, this field of research has gained momentum, especially among scholars in the field of sustainability [36]. The main driver behind the emergence of transition research has been the search for new insights and ideas to understand how to steer clear from unsustainability lock-in and how to mobilise and empower disruptive innovations and transformative capacity from the system toward desirable sustainability transitions [37]. In transition management research, three approaches to governance can be discerned—analysis, evaluation, and experimental exploration of the transition governance [37]. The first two approaches provide knowledge on how transition processes can be developed to trigger

and sustain change, but do not reveal the actual learning process on the ground and the role of different actors in such processes. The latter—the experimental exploration of transition governance—is represented by the third, more operational approach, which is relevant for the conceptual design to be developed here. This explorative research has still not found widespread attention [13,38]. It is linked to the growing interest in actor roles and agency in sustainability transitions [22,39–41] and their ideal types of roles. In this context, one can investigate the power relations among actors [42,43], the roles and drivers of individual actors [44], or the actors shaping the transition [22]. This latter route forms the starting point of the conceptual design developed here.

In further elaborating the roles played by actors shaping the CE transition, national governments are considered to be one of the leading actors [22]. They can steer the CE transition by removing fundamental barriers and creating the right conditions [45]. Through regulatory, fiscal and other measures, system innovations can be prompted, and the potential of new technologies is utilised [40]. The reality, however, is that synergistic governmental interventions to accelerate the CE transition are lacking in the European Union and its member states [46,47]. This implies that fundamental barriers still hinder the implementation of CE, preventing an acceleration of the transition. Whether city and regional government actors alone can create the necessary system change is not yet known [22]. However, referring to Späth and Rohrer [48], Fischer and Newig [22] expect that these actors are faced with limited opportunities due to regulatory, administrative, political and other constraints. Similarly, Campbell-Johnston et al. [49] observe a variety of hard and soft barriers, among which is the limited capacity to influence value chains and businesses. To implement circular economy locally in EU countries, other actors besides local government should therefore be involved in the transition governance, particularly the market [22].

How to empower circular business and go beyond the boundaries of individual companies at local level is an underexamined issue in the literature [19,50]. This holds particularly for the question of how to govern effectively towards the CE transition and overcome the area of tension between regime and niche actors. Regime actors representing established practices are usually hampered by risk avoidance considerations and special interests, with much to lose in the short run [13]. Newcomers to the market (niche actors) who focus on innovations that deviate from existing regimes [51] are less affected by these constraints. They can create a starting point for systemic change, although this is also difficult because lock-in mechanisms can stabilise the incumbent regime [24]. As niche actors often lack the broader acceptance of their innovations in the market, they can only gain momentum if the general perception of these innovations shifts towards greater acceptance, if the alignment of various learning processes results in a stable configuration ('dominant design'), and if networks become bigger. Especially the participation of powerful actors (government and industry) may convey legitimacy and direct resources to niche innovations [52,53]. From a governance perspective, it is therefore obvious that neither niche actors nor innovative regime actors can create the CE transition when acting alone.

As both local government and market actors are constrained in governing the CE transition individually, intermediaries are seen as potentially highly influential actors to orchestrate such a transformative change process [22,40]. Therefore, intermediaries need to be included in the governance model to be developed. With the exception of some early studies [54], the role of intermediaries in sustainability transition processes has only relatively recently gained traction [26–28,55]. Publications on intermediaries in sustainability-oriented innovation mainly focus on their role in financial sustainability rather than on the environmental sustainability performance or on green innovations created with the help of the intermediary [28]. Within the small group of studies on the latter issue, only few examine how green innovation intermediaries interact with niche actors to help create cross-level change (niche to regime and regime to niche). The sustainability-oriented innovation intermediaries that focus on green innovation can be defined as "organisations (or persons) that assist firms in the eco-innovation process by providing external impulse, motivation, advice and other specific support often by acting as an agent or broker between two or more parties" [56], p. 3.

Kanda et al. [26] stress that sustainability innovation differs in various aspects from the conventional, company-level innovation predominantly studied in innovation management literature. They argue that due to its complexity and systemic nature, sustainability innovation networking and cooperation with external partners are essential. Changes in raw material or components used, logistical or technical integration, and the redesign of products and services [26] are often required. Thus, cooperation with suppliers is essential to access inputs or components with environmentally friendly features. As this also requires specific information and skills (e.g., eco-design and life cycle thinking), cooperation with institutions such as universities, consultants, and research centres is also important [26]. Finally, to encourage broader diffusion of the technology innovation and the corresponding transformation of the regime, policy changes also need to take place [28]. By supporting and influencing such policy changes, the intermediary can play a role in tackling the environmental externalities [26]. In that case, the intermediary becomes the person(s) or organisation that develops proper interfaces between the triple-helix actors (business, research, and government). Through a process of empowering, these intermediaries can help create system change [57]. In line with this perspective, Barrie et al. [58] stress the importance of system-level triple-helix intermediaries to facilitate multi-level knowledge transfer between policy makers and actors. Moreover, they stress the importance of intermediaries in promoting a ‘stretch-and-transform’ approach instead of the conventional ‘fit-and-conform’ approach to enhancing CE. Finally, Barrie et al. [58] call for a more networked form of governance as opposed to the traditional linear approach to innovation pursued by most governments [58]. When system thinking is combined with the notion of reflexivity, governance and policy evolve from singular points of intervention to a system of continual feedback, they argue [58].

Despite the attempts to define the function of intermediaries in sustainability transitions literature, interpretations vary. Based on the diversity of aims and activities intermediaries pursue, Kivimaa et al. [27] distinguish five different types of transition intermediaries: (1) process, (2) user, (3) regime-based, (4) niche, and (5) systemic intermediaries. Process intermediaries facilitate a change process in a specific context and user intermediaries translate new niche technologies to users. Regime-based intermediaries are tied to the prevailing socio-technical regime, while niche intermediaries are typically working to experiment and advance activities of a particular niche. Systemic intermediaries are the only ones promoting an explicit transition agenda and “are crucial to guide transitions from a whole-system perspective, having the potential to disrupt existing socio-technical configurations and to assess a range of viable alternatives across multiple niches, regimes and spatial scales. Their importance lies in being unbiased towards selected socio-technical alternatives, while having a strong normative orientation for transformative change” [27], p. 1027.

Research on the function these various intermediaries fulfil in sustainability transition is scarce. In the few studies available, intermediaries primarily focus on two processes—(1) niche-to-regime interactions and (2) regime-to-niche interactions. They aim to help expand niche activities to the regime and/or draw upon the regime to support niche development and protection [28]. However, by acting only in the space between two out of the three triple-helix actors, such intermediaries are unable to fully understand or influence the wider innovation network dynamics that foster regime change [58]. Only a few authors refer to the function of systemic intermediaries as defined by Kivimaa et al. [27]. They relate to the importance of intermediaries that help create the conditions for sustainability experiments to scale up and encourage policy change [26–28,58]. Gliedt et al. [28] refer to a particular intermediary (‘political entrepreneur’) who fulfils this function. Others include this latter function in that of a systemic intermediary (e.g., references [27,58]).

Relying upon the above analysis, the description of Kivimaa et al. [27] of systemic intermediaries seems to come closest to the function intermediaries fulfil in the complex change processes toward CE analysed here. Alongside local government and market actors, they are key actors in the regional governance of CE implementation. Because the intermediaries rely on knowledge and expertise in fulfilling their function, research and educational institutions and consultants are also important actors in the governance structure. To link the identified actors to the system-building activities they perform

in the regional governance of CE implementation, use has been made of the technological innovation system (TIS) approach in innovation science [30]. TIS refers to a dynamic socio-technical system of actors and their networks, whose interactions are guided by formal and informal institutions with an overarching aim to develop and implement particular technologies [59]. To analyse the performance of TIS systems, the literature suggests a set of seven key system functions that need to be performed at a certain quality standard [30]. Through the application of the TIS approach, insight has been gained in system-building activities from a technological rather than an entrepreneurial perspective. As this paper addresses the implementation of CE from the latter perspective, the rephrased TIS model of Planko et al. [60] will be used here as a starting point. Their model draws up a practical strategy framework that can be used by entrepreneurs and entrepreneurial managers for strategy making. Based on a case study of collective system building in the Dutch smart-grid sector, Planko et al. [60] group the system-building activities into four main the following functions: (1) technology development and optimisation, (2) market creation, (3) socio-cultural changes, and (4) coordination. The added value of the model of Planko et al. [60] is that it incorporates the function of socio-cultural changes, which is often neglected in the TIS literature. Moreover, coordination is seen as a separate function, which allows for the inclusion of the transition broker as a key systemic intermediary. However, due to its emphasis on the entrepreneur's perspective, the model also has its limitations by not explicitly distinguishing the function fulfilled by government. As this function of creating the appropriate preconditions is crucial in the regional governance of CE implementation, it will be added to the conceptual design developed here (see Figure 1). This conceptual design will be adopted as the theoretical framework in the analysis presented.

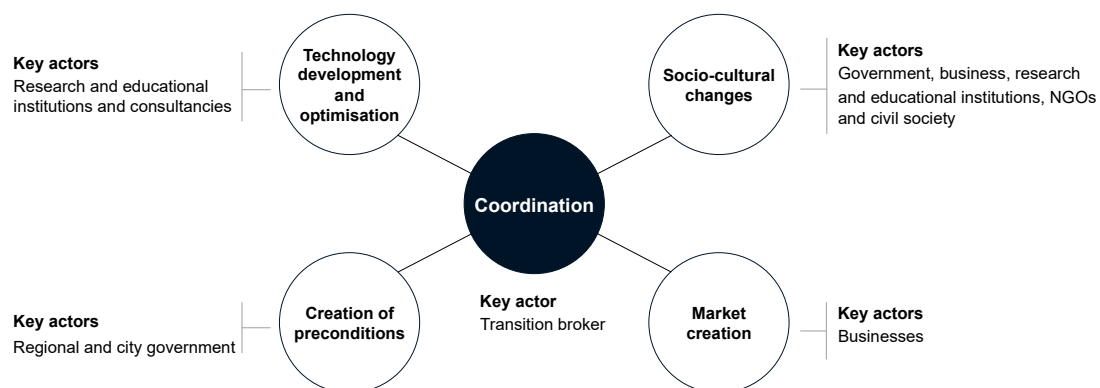


Figure 1. Conceptual design of the regional governance in implementing the circular economy.

3. Methodology

The six Dutch regions on which the analysis is based were selected because they profile themselves as frontrunners in CE implementation at a regional scale. The six regions are spread across the country, together representing 174 municipalities and more than eight million inhabitants (see Figure 2). This is about half of the Netherlands (which has a total of 355 municipalities and 17.3 million inhabitants).

Part of the Netherlands		Range of activities	
		Municipalities	Inhabitants, mln
Central	1 Province of Utrecht	26	1.295
East	2 Provinces Gelderland and Overijssel	76	3.000
East	3 Nijmegen Area	13	0.250
North	4 Friesland	18	0.650
South	5 Mid Brabant	9	0.450
West	6 Amsterdam Metropolitan Area	32	2.48

Figure 2. Overview of six regions representing 174 municipalities and more than eight million inhabitants.

After several years of experience with CE implementation, the transition brokers of these six regions were eager to scale up successful initiatives and be more involved in the preparation of new policies on CE in the Netherlands and the EU. They jointly expressed the need to connect their regional initiatives with national policies and establish a platform where regional transition brokers could learn from each other. With support from the Ministry of Infrastructure and Water Management, a platform of regional transition brokers was set up in autumn 2019, coordinated by a civil servant of the Ministry in close cooperation with the Netherlands' employers' organisation VNO-NCW. For the analysis presented here, one or more transition brokers from each of the six regions were selected as key actors.

To begin with, a pilot study was carried out in the Amsterdam Metropolitan Area between January 2015 and February 2020. Various parties present in this region have joined forces to move toward a circular economy because of the opportunities this could offer the region, e.g., an attractive, innovative environment, new business development, increased employment, and lower environmental impact. The pilot study focuses on the implementation of a regional programme on CE set up and executed by two transition brokers of the Amsterdam Economic Board in close cooperation with their partners (viz. local government, industry, and research institutes and universities). The AMEC is a triple helix organisation financed by its members. The experiences gained in the Amsterdam Metropolitan Area were used to structure the qualitative, comparative analysis of the six regions.

The pilot study showed that the regional CE programme has evolved over time. It consists of four phases, which can be considered the main system-building activities [61]. In phase 1 (2015), the programme was drafted by one of the two transition brokers, and, after negotiations, it was adopted by local government and the Amsterdam Economic Board. In phase 2 (starting in late 2015), the execution of the programme began; this focused on building coalitions of partners that were willing to develop new CE business. In phase 3 (starting in 2019), the first successful examples are being scaled up. All these activities may ultimately lead to phase 4, in which CE will be considered normal ('mainstream'). This phase has not been reached yet; it is therefore not included in the analysis [61]. The analysis also generates information about the roles played by the two transition brokers, including the division of tasks with other actors, particularly local government. The roles fulfilled by the two transition brokers varied over time. The different roles were summarised in an

overview. The four-phases evolutionary model and the overview of roles formed the starting point of the comparative analysis of six Dutch regions.

The qualitative analyses of the other five regions were based on a one-hour interview with one regional intermediary per region (or, in two cases, with two, respectively three, intermediaries). In advance, the website and documents provided by the interviewees were studied. The interview was based on a structured questionnaire. So that they could prepare their answers, the interviewees received the questionnaire beforehand. It consists of four parts:

1. Evolution of the regional CE programme in terms of content and process;
2. Their roles as intermediary in the course of the execution of the programme;
3. Reflection on the competencies of the transition brokers;
4. Governance: division of labour between themselves and other actors in the region, especially the local government.

In part 1, the interviewees were asked to describe the evolution of the regional CE programme. Based on this description, it was discussed with them whether the four-phases model derived from the pilot case was applicable to their case, too. In part 2, the interviewees were first invited to sum up the roles that they had played; next, their answers were compared with the overview derived from the pilot case. This led to some revisions of the original overview and a dialogue about the interpretation of the differences and similarities. Following this, the participants were asked which competencies they considered to be important in adequately fulfilling those roles. The answers were summarised and presented to the interviewees for consent. Finally, the division of labour between transition brokers and other key actors, particularly local government, was discussed. Use was made of an inventory of the CE instruments applied by four provinces [62]. A summary of this inventory was sent to the interviewees in advance, accompanied by a list of instruments used by municipalities. During the interview, the participants could indicate which instruments they found to be crucial to be adopted by both provinces and municipalities in implementing CE, and which aspects of governance are not covered by local government but can be seen as an obvious function for themselves as intermediary.

After all interviews had been transcribed, they were checked by the interviewees. A draft report was then produced, containing the cross-comparison of the six cases. To validate the data and verify the interpretation of the results, the draft report was shared with the interviewees. Their comments were included in a final report, which provided the data for this paper.

4. Results

4.1. Summary of the Evolution of the Regional CE Programmes

First, a summary of the evolution of the regional CE programmes in the six regions will be provided below, based on the interviews and written information provided.

4.1.1. Province of Utrecht

The multi-stakeholder initiative for a regional programme in the Province of Utrecht included an NGO (the Nature and Environment Federation Utrecht), a knowledge broker from the Utrecht Sustainability Institute at Utrecht University, the municipalities of Utrecht and Amersfoort, and the Economic Board Utrecht. In 2015, a CE programme, 'Towards Circular Region Utrecht' ('Op weg naar Cirkelregio Utrecht'), was drafted, combined with an economic assessment of its potential benefits, performed by the applied research institute TNO. Secondly, the triple-helix cooperation alliance was set up. Simultaneously, circular initiatives were started within a light programme structure. Initial focus points were construction and demolition in the building sector, waste-free zones, and bio-based economy. After lobbying during the municipal elections (2018) and the elections for the province of Utrecht (2019), a budget became available for separate projects but not for a continuous programme. However, the alliance has gained more traction since then.

4.1.2. Provinces of Gelderland and Overijssel

In 2015, the triple-helix organisation Kiemt and VNO-NCW Midden—a regional network of the business association VNO-NCW—launched their Programmatic Approach Circular Entrepreneurship, which led to a three-year programme named CIRCLES. This programme was financed through a European Fund for Regional Development (EFRO). The cooperation alliance adopted a triple-helix approach and focused on small and medium-sized enterprises (SMEs). The objective was twofold: (1) to find CE frontrunners and support them in scaling and (2) to improve cooperation among intermediaries. After a first stage, the intention was to further professionalise the approach. CIRCLES organises the front of the societal transition and connects CE frontrunners in eight subregions, focused on specific themes. Examples are Food Valley Circular Wageningen; circular construction Achterhoek; manufacturing Industry Apeldoorn; water authority cluster Rivierenland; logistics and plastics Zwolle; and carpet and plastic cluster Arnhem-Nijmegen.

4.1.3. Nijmegen Region

Two waste management companies (DAR and ARN) and a cooperation alliance of 10 municipalities in Nijmegen region initiated the Nijmegen region's CE initiative in 2016. First, TNO analysed the opportunities of CE, while the consultancy firm Metabolic conducted a study into the main resource streams in the region. In 2019, the 'Circular Council' was created and formulated a CE programme. This triple-helix organisation consisted of companies (including one of the main banks), the 13 municipalities and the two universities. In this way, a network was mobilised that could make smart use of existing networks. The execution body, which acted as intermediary, consisted of a team of 3.7 full-time equivalent (fte). The governance was not formally arranged. Five resource chains were selected—health, construction, consumption goods, agrifood, and the manufacturing industry—and the following three intersecting themes: knowledge/research, sustainable procurement, and circular finance.

4.1.4. Friesland

Circular Friesland was initiated in 2015 by the director of the waste management company Omrin in cooperation with 20 companies, the municipality of Leeuwarden, and the province of Friesland. First, an analysis was conducted of the main resource streams in Friesland; simultaneously, the concept of CE was further elaborated. In 2016, the association Circular Friesland was established, representing the quadruple helix: business, research and education institutes, local government and residents. Ten themes were chosen, each of which was connected to a 'booster'. The starting point was a platform strategy, which respected the interest and focus of the parties involved and thus created co-ownership. The execution team acted as intermediaries to accelerate the process and guard the ambition level. This team formulates the plans, and the board and the general meeting of Circular Friesland make the decision. Finance was first available through the European Fund for Regional Development (EFRO). At present, the network is financed by its members and the province of Friesland.

4.1.5. Mid-Brabant Region

The regional initiative started in late 2018 on instigation of the Municipality of Tilburg's alderman for sustainability. It focuses on 'makerspaces': shared facilities where innovations are prototyped, tested and further developed into marketable products of production technologies. These organisations work with partners from research and education institutes, business and local government to develop new concepts, preferably in field labs. CE focus areas are textiles, construction, manufacturing/smart industries, and food. All initiatives have a bottom-up structure and are organised in an association. The intermediaries play a connecting role between SMEs and the circular system that is being built. For the overall masterplan, EU and local funds are available.

4.1.6. Amsterdam Metropolitan Area

The CE programme of the Amsterdam Economic Board, a public/private organisation, was initiated in January 2015. This programme was complementary to the activities of the Amsterdam Area's 32 municipalities and two provinces. It consisted of two strategies: Strategy 1 focuses on renewing product chains via circular procurement (56 organisations presently involved); Strategy 2 aims at closing the loop of resource streams (until now, 22 business cases built). Through a triple-helix cooperation between business, local government and research and education institutes, a network of circular frontrunners has been established. In addition to this CE programme, the Board also hosts a Smart City Programme, which supports citizens' initiatives in various fields including CE. Finally, special attention is paid to the development of knowledge and competencies in CE at all educational levels, from elementary schools to universities. The budget is limited to the efforts of a few intermediaries of the Board.

4.2. *Comparison of the Outcomes of the Regions' CE Programmes*

When comparing the CE programmes in the six regions, various similarities come to the fore. The CE programmes are orchestrated by intermediaries who work in a triple-helix or quadruple-helix context. Their objective is to accelerate the transition to a circular economy through mediation between diverse stakeholders. The way in which the six regional initiatives are organised differs. It can be an association, an informal cooperation alliance, part of a public/private organisation or a private organisation. The budgets available vary significantly, too, depending on the regional support that can be mobilised. All CE programmes have firm regional support from local government and were instigated by one or a few actors. They all felt the need to involve a triple- or quadruple-helix stakeholder group and ask one or more persons to function as intermediaries.

The programmatic approach in the five regions consists of a similar four-phase model as the pilot case. In phase 1, 'Drafting and negotiating the CE programme', the intermediaries launch the programme and select thematic focus areas. These areas are chosen on the basis of the economic strength of the region, environmental impact, bottom-up input and/or national policies. Most transition brokers focus on one or both of the two main strategies—(1) renewing product chains via circular procurement and (2) closing the loop of resource streams to create high-value products, materials and resources. In phase 2, 'preparing and helping to build circular initiatives', the intermediaries safeguard a high standard when it comes to ambition and commitment, only inviting those companies who are willing to meet the targets. Besides lead actors (particularly frontrunners in industry), the intermediaries also invite other partners that are needed to jointly create the new circular initiatives. This could be other companies and research institutes, but also local government in its role as bidder, regulator, spatial planner or financier. In phase 3, 'repeating and upscaling successful circular initiatives', the intermediaries begin to reap the rewards of previous efforts, which may ultimately lead to a mainstreaming of CE (phase 4). None of the six regions had yet reached phase 4 when the case studies were conducted. Most of them were in phase 2, while a few had also started phase 3 activities. The activities carried out in the four phases can be considered the main system-building activities performed by the intermediaries.

When asked whether they considered themselves transition brokers, the intermediaries hesitated. They recognised their function in the term, although a few preferred a more interventionist concept such as 'transition tipper' or 'musketeer'. However, in their daily practice, most of them preferred to use 'regional accelerator', stating this sounded less academic than 'transition broker'.

The way in which the interviewees described their function as a transition broker was largely similar. A compilation of their remarks led to the following description, which was endorsed by all of them:

'We help create and accelerate the system change to a circular economy from a neutral position. We do this in a coalition of parties: companies, government, education and research institutes and sometimes also citizens. Our efforts focus primarily on circular initiatives with a positive impact

on prosperity, wellbeing and the environment. These initiatives are often taken by frontrunners in industry. They need other parties to establish their business case, to be able to scale up and to change the current business model. An individual company alone cannot adjust the world around it to the new economy. It has to do that with others. This means that a coalition of willing parties must be formed that preferably takes ownership to realise a new, circular initiative. What this coalition looks like and who it should involve is case specific. To keep control of the product chains and the security of supply, the aim should be to close the loops at the lowest scale possible, while taking the highest viable ambition standard into account. The function of the transition broker is not—as it has traditionally been—to stimulate companies to circular entrepreneurship via innovation funds and advice about an individual company's business case. Much more frequently, a transition broker has to deal with the question what a business needs from other parties to be able to sell and scale up its circular product or service in the market and create system change. The task of the transition broker is to search for promising circular initiatives, find an interested lead business actor, connect this actor with relevant parties, help realise the necessary preconditions, make sure that impactful, circular initiatives can be established and communicate those. Moreover, the transition broker must motivate the majority of companies to join CE initiatives and help establish the link between local and national governance'.

To relate the above description to the literature, the interviewees were requested to respond to the description of the five different types of intermediaries as distinguished by Kivimaa et al. [27]—(1) process, (2) user, (3) regime-based, (4) niche, and (5) systemic intermediaries. This description was provided before the interview. All interviewees consider themselves a systemic intermediary. However, interviewees of three regions stressed that they also acted as a process intermediary to help create change at systemic level. According to the interviewees, the roles they fulfil as transition broker mostly resemble those derived from the pilot case in the Amsterdam Area. However, they added three more roles and changed the wording of one other role. This led to the following overview of roles in the various phases of the CE implementation process at regional level (see Figure 3).

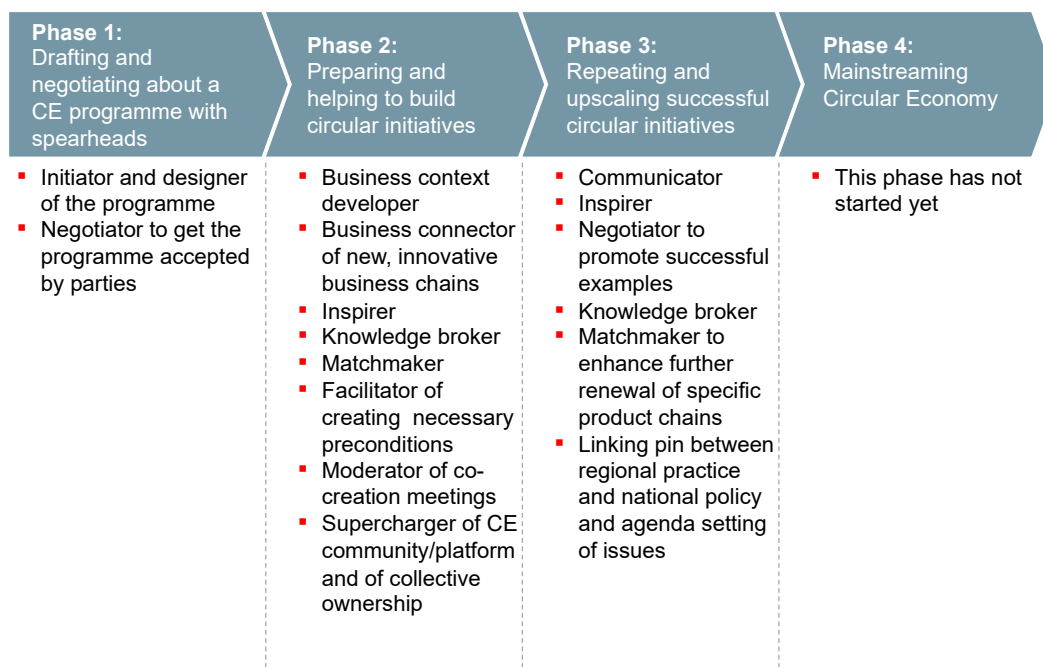


Figure 3. Overview of the roles fulfilled by transition brokers in implementing circular economy (CE) at the regional level over time.

Figure 3 clearly demonstrates the wide variety of roles transition brokers must fulfil. These vary depending on the phase of implementation, the particular implementation strategy and the broader institutional context. The roles of the transition brokers in phase 1 were quite uniform. In phases 2 and

3, their roles varied more widely, depending on the institutional setting and the particular circular initiatives or upscaling activities. Phase 4, aimed at mainstreaming CE, has not yet been launched in any of the regions.

The questions which competencies transition brokers need to adequately fulfil their function did not lead to much difference of opinion. The interviewees agreed upon the following combination of competencies:

- To be entrepreneurial, dare to leave your comfort zone, persevere, be impatient and be willing to follow up with contacts
- To enthuse and inspire others to cooperate
- To think and act from a system perspective but at the same time to be pragmatic
- To get the idea of CE accepted in a variety of businesses and organisations, translate your activities into the language of other organisations and not appear threatening
- To act in the collective interest and be professional enough to stand above the parties
- To have a very broad knowledge base in CE innovations, the regional business environment and the regional political culture

As it can be difficult to combine all these requirements in one person, the interviewees emphasised that two or more persons can be included to cover all competencies needed.

Finally, the division of labour between the transition brokers and other key actors was discussed. The system-building activities of business were evident. They focus on (a) developing commercially viable circular products and services, (b) building circular business in partnership, (c) cooperating with other stakeholders in product chains and/or the local context, and (d) developing a circular business model. While market creation lies primarily in the hands of business, in the case of CE it can be actively supported by circular procurement.

The key system-building activities of research and educational institutions and consultancies are also self-explanatory: (a) knowledge development and exchange and (b) co-creation of circular products and services. As the system-building activities related to the function of 'socio-cultural changes' are the responsibility of all actors, these were derived from the general observations of the transition brokers. The main activities identified here are (a) changing behaviour (e.g., of consumers, users or bidders), (b) creating institutional changes to anchor circular economy in organisations, (c) effecting changes in the education system, and (d) generating a pool of skilled labour.

What needed particular attention in the interviews was the division of labour between intermediaries and local government. To specify the system-building activities of local government, an inventory of the CE instruments applied by four provinces was used [62]. The list of system-building activities derived from this inventory was complemented with additional municipal activities. In the interview, the interviewees could indicate which system-building activities on the list they found crucial for both provinces and municipalities to apply in implementing CE. They were also asked which aspects of regional governance were not covered by local government but could be considered an obvious role for themselves as intermediary. The response of the interviewees led to an overview of the main system-building activities of provinces and municipalities, with which all interviewees agreed (see Figure 4).

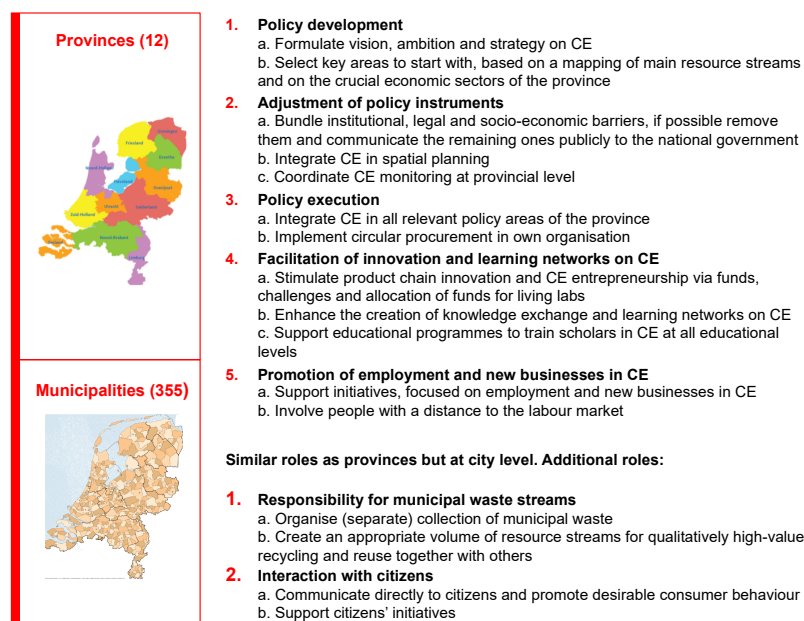


Figure 4. The main system-building activities of local government (provinces and municipalities) in implementing the circular economy locally.

Figure 4 shows that the transition brokers expect that both provinces and municipalities develop their own CE policy, adjust existing policy instruments in view of CE, execute CE policy in their daily practice, promote employment and new businesses in CE, and facilitate innovation and learning networks on CE. Moreover, municipalities carry out a number of additional activities, viz. responsibility for municipal waste streams and interaction with citizens. All the system-building activities mentioned perfectly match with the interventions commonly expected of government. However, the system-building activities fulfilled by the transition brokers are not covered by local government. As one of them resolutely stated, ‘Local government can definitely not take on the task of the transition brokers. Local government should be busy with the creation of the preconditions. The transition brokers orchestrate the implementation process and act as an intermediary between the parties that need to cooperate in order to build a viable business case and develop a business model that reflects the needs of all parties’. All transition brokers agree with this division of labour. All of them are positive about the pleasant cooperation with local government and encounter no serious problems in fulfilling their function vis-à-vis local government. On the contrary, they feel appreciated by local government to carry out this function of system orchestration.

5. Discussion

The analysis presented shows that the transition brokers in the six Dutch regions studied fulfil a particular function in the regional governance of implementing CE. As an intermediate actor, they can enhance processes of change, build alliances, help create the necessary conditions and develop impactful circular initiatives without being perceived as acting out of self-interest. They mediate between companies and other relevant actors to prepare, negotiate and seal a circular deal and help scale up and ultimately mainstream these initiatives. Because they are not hindered by particular institutional and political constraints or vested interests, they are usually seen as trustworthy in their efforts of building coalitions with parties that are willing to make transformative steps forward. They facilitate both the process (learning, communication) and content (feeding new information and seeking ambitious solutions) of the transition. In their ability to cross borders and broaden objectives, they can act in ways that are difficult for other parties (such as representatives of government, research institutes, consultants, NGOs, citizens, and business) to copy. Whether transition brokers are given

optimal room to operate successfully largely depends on the mandate provided by key actors and the trust these actors have in the transition brokers and the organisation that supports them.

A comparison of the CE programmes orchestrated by the transition brokers in the six regions reveals major similarities. Besides the large overlap in the description of their function in the overall governance, they all operate in a triple-helix or quadruple-helix context. Moreover, the approach of all CE programmes can be divided into the following four main system-building activities: (1) 'drafting and negotiating the CE programme', (2) 'preparing and helping to build circular initiatives', (3) 'repeating and upscaling successful circular initiatives', and (4) 'mainstreaming CE'. What differs is the organisational form and budgets available. Instead of the conventional approach focused on company-level innovation, all transition brokers are concerned with transformative change at system level. They consider themselves systemic intermediaries as defined by Kivimaa et al. [27]. Additionally, however, they often associate themselves with process intermediaries, because they act as process-oriented change agents. What kind of systemic intermediation by transition brokers takes place at regional level and how it changes over time has not been studied empirically before in the context of CE [27].

This study reveals that the roles played by transition brokers vary much more than the ideal type of roles described in the literature [27,29,63]. Their roles change in the course of time and are content and context dependent. Although Wittmayer and Schöpke [63] share this observation, they have not studied the detailed scope of roles in the various phases of the transition process. The kind of function fulfilled by the transition brokers clearly differs from the traditional role of managing a project with a fixed objective, timeline and output. Instead, the transition brokers orchestrate a process in which they have to act flexibly and cannot precisely plan all actions. Some initiatives gain momentum more easily than others. This depends on the power and willingness of the coalition of relevant parties to act and on whether the preconditions and incentives needed to create a viable business case are in place. Transition brokers need to be keen to seize 'windows of opportunity' that might come along unexpectedly [64]. For instance, some key actors might at first be reluctant to join but change their mind after a while. Knowing what happens in a region is therefore crucial in order to pick up the right signals. Thus, contrary to the dominant view in organisation theory [65], the CE transition process cannot be precisely planned and is subject to unexpected obstacles or opportunities.

Fulfilling these different roles as intermediary requires a specific set of competences. Transition brokers need to

- Be entrepreneurial, dare to leave your comfort zone, persevere, be impatient and be willing to follow up with contacts;
- Enthuse and inspire others to cooperate;
- Think and act from a system perspective but at the same time to be pragmatic;
- Get the idea of CE accepted in a variety of businesses, local government and organisations, translate your activities into the language of other organisations, and not appear threatening;
- Act in the collective interest and be professional enough to stand above the parties;
- Have a very broad knowledge base in CE innovations, the regional business environment, and the regional political culture.

Because it may be difficult to combine these requirements in one person, two or more persons often need to be involved to cover all competencies. In fact, the role of transition broker is a new type of function. No specific course or educational training presently exists to qualify for the role of transition broker. Currently, transition brokers are usually selected on the basis of the expectation that they can fulfil the function. Whether this is the case then becomes clear in practice. A number of regions have asked for the assistance of researchers in the field of transition management to better understand the particularities of orchestrating system innovation. However, the processes of applying these theoretical notions to their own practice are mainly a matter of learning by doing.

As a growing number of transition brokers become active in CE in the Netherlands, the call for setting up learning platforms to share experiences as transition broker is becoming louder. An example is the recently established platform of regional transition brokers. It is to be expected that when the need for professional training in performing the function of a transition broker persists, more formalised programmes will be introduced. With the help of ICT learning, communities can be created, and digital training programmes provided, which will accelerate the development of competent transition brokers. However, doing the work in practice and getting feedback from colleagues on the spot, remains the best way to increase the qualifications needed.

The competences of a transition broker do not tend to match well with those of the average civil servant. In the latter case, competencies such as problem solving, operational effectiveness and governance sensitivity are dominant [66], instead of being entrepreneurial, daring to leave their comfort zone and cooperating in a triple- or quadruple-helix setting. According to the transition brokers, local government should be concerned with the creation of the preconditions to make CE implementation possible. It is not their natural habitus to act as intermediary between parties willing to jointly develop circular business at system level. However, it should be noted that local government can create a special unit for transition brokers within its organisation. This only works if persons with the right qualifications are assigned to this and given the freedom to operate within the context of the bureaucratic, governmental structure.

The conceptual design of regional governance in implementing CE, which has been formulated as theoretical framework, could be further elaborated and rephrased on the basis of the experiences of the transition brokers in the six Dutch regions. The transition brokers could clearly identify their own 'system orchestration' function vis-à-vis the function fulfilled by other key actors. They attributed the following functions respectively to business, local government and research and educational institutions, and consultancies: market creation (often stimulated by circular procurement); creation of preconditions, and research and technology development (called 'technology development and optimisation' by Planko et al. [60]). The function of 'creating socio-cultural change' was considered as cutting across all sectors, meaning all actors bear responsibility for it.

The views among the transition brokers also converged when it came to the system-building activities performed under the heading of each function. The separation they made between the task of local government to carry out policy interventions and their own task seems more nuanced than is discussed in the literature. Some argue that this task should solely be assigned to local government, or, as Gliedt et al. [28] suggest, to a political entrepreneur, while others also include this task in that of a systemic intermediary [27,58]. This study reveals that the answer is not clear-cut. Experiences show that transition brokers can identify the preconditions required to realise circular business and involve local government as needed. Local government can use its toolbox of policy instruments to help remove barriers, if possible, and create linkages with policy arenas on national and EU level to address the remaining obstacles [49]. Through this division of labour, local government can stick to its conventional role of regulator, facilitator, financer and guardian of human wellbeing and common goods. Transition brokers can create a more networked form of governance, in which system thinking is combined with the notion of reflexivity [58].

Based on the above findings, the new 'Model of regional governance in implementing CE' can be formulated, which is presented in Figure 5.

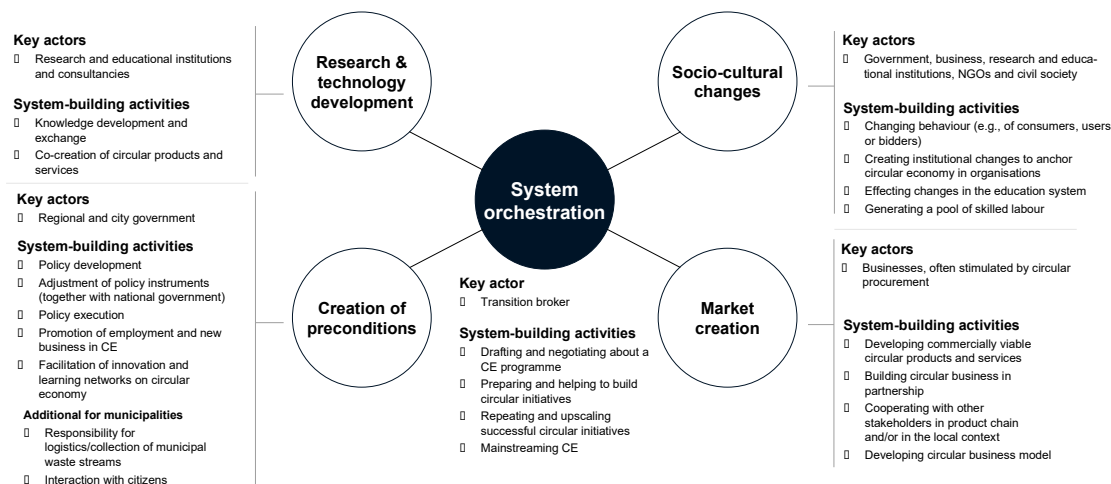


Figure 5. Model of regional governance in implementing the circular economy.

Figure 5 summarises the main system-building activities clustered into the following five different functions: research and technology development, creation of preconditions, market creation, socio-cultural changes, and system orchestration. The latter function is placed in the middle of the figure, as this is the interlinking element between all functions in the system. By rearranging the model of Planko et al. [60] according to the system-building activities at system level, the model of regional governance in implementing CE could be created. This model is also linked to national and EU policies. Foremost, local government is responsible to draw attention nationally to the fundamental barriers and positive incentives to implementing CE locally. Politicians representing local government are eminently equipped to lobby and put pressure on the national government to change national and EU policies. Additionally, regional transition brokers united in a national learning platform can provide direct input into the preparation of new policies geared toward CE.

This model clearly differs from the standard, linear model of regional governance. The latter model represents a traditional manner of supporting product and process innovation at individual company level. However, the regional implementation of CE implies breaking down the linear economic system and gradually replacing it with a new circular system. This requires a triple- or quadruple-helix innovation system approach, in which relevant stakeholders jointly create circular initiatives. To establish alignment of stakeholders and give priority to innovative, circular initiatives, the transition brokers fulfil a crucial, intermediary function. They can help generate system change through a ‘stretch-and-transform’ process of empowering various, relevant actors. Their role is overlooked in the standard model of regional governance, but they take a central position in the more networked form of governance presented here. Other authors [57,58] also advocate this new model in recent literature on innovation science, but it is not yet substantiated by practical cases. The added value of this study is that it supports their conceptual statements with empirical data and designs a model based on these data.

6. Conclusions

This paper has aimed to answer the following questions: Which governance gap can intermediaries (here called ‘transition brokers’) bridge in supporting market actors, particularly newcomers to implement CE at regional level? Which function do they fulfil complementary to local government and other parties? What does this imply in terms of the system-building activities and roles being performed by intermediaries vis-à-vis the other key actors and which competences do intermediaries need? These questions are insufficiently explored empirically in the literature. Based on a case study of the function of transition brokers in governing the CE transition in six different Dutch regions, the following conclusions can be drawn.

As an intermediate, neutral actor, transition brokers can enhance processes of change at regional level, build alliances, help create the necessary preconditions and develop impactful circular initiatives without being perceived as acting out of self-interest. They mediate between companies and other, relevant actors to prepare, negotiate and seal a circular deal and help scale up and ultimately mainstream these initiatives. The transition process they orchestrate cannot be accurately planned and is subject to unexpected obstacles or opportunities. This contradicts the dominant view in organisation theory [65]. In performing this function, transition brokers fulfil a variety of roles in a multi-stakeholder setting. The roles involved in implementing CE at regional level have not previously been studied empirically. The study shows that these roles fluctuate much more than the ideal type of intermediary roles described in the literature [27,29,63]. They change in the course of time and are content and context dependent. Executing these roles requires a number of specific competencies, varying from being entrepreneurial to daring to leave one's comfort zone and being able to motivate others in order to get the idea of CE accepted in a variety of businesses and organisations.

The empirical findings of the case study provided the data for a new 'Model of the regional governance in implementing CE'. This model is a deepening of the conceptual design, which was derived from the rephrased TIS model of Planko et al. [60] and used as theoretical framework. The newly developed model summarises the main system-building activities clustered in five different functions: market creation (key actor: business, often stimulated by circular procurement); research and technology development (key actors: research and educational institutions and consultancies); socio-cultural changes (key actors: government, business, research and educational institutions, NGOs and civil society); creation of preconditions (key actor: local government); and system orchestration (key actor: transition broker). Contrary to the conventional model of supporting product and process innovation at individual companies, this new model represents a more networked form of governance at system level in a triple- or quadruple-helix context. To create alignment of stakeholders and help generate system change through a 'stretch-and-transform' process, the transition brokers fulfil a crucial intermediary function. The basic ideas behind this new model are also advocated in recent literature on innovation science by other authors [57,58] but have not yet been substantiated by an evidence-based account.

The added value of this study for scholars is an increased understanding of how the governance of the CE implementation at regional level can be organised in a more networked form of governance, rather than a conventional, linear one. It also highlights the importance of intermediaries for expanding the CE ambition and create the connections between the actors that need to be involved in order to make a system change. This function is not usually fulfilled. The study opens up a new area of research on the role of systemic intermediaries and new forms of CE governance, which has so far hardly received any attention on the basis of real-life cases. For practitioners, the study can provide guidance in how to act as transition broker and which competences are needed. The list of roles performed in the various system-building activities can be helpful for carrying out the work of a transition broker. For other key actors, the newly developed model of regional governance can clarify the system-building activities and responsibilities of each actor in the CE implementation. This is useful for arranging a clear division of labour, which often remains undiscussed.

The fact that a key function of transition brokers is that of system orchestrator also has managerial implications. Fulfilling this function requires a particular set of competences, for which no specific training or course exists yet. It is recommended to respect the added value of transition brokers and to introduce dedicated education programmes and training on the job to increase the number of qualified transition brokers.

This study has several limitations. First, the findings are based on a Dutch study. Before generalising its outcome, it is important to perform similar research in other socio-political and cultural contexts. As the Netherlands has a long-standing tradition of cooperation, consensus-building and democratic self-rule [67], this case study might not be representative of other countries. It is possible that elsewhere the interaction between business, government, and civil society is more antagonistic. This will make the networked form of governance of the CE transition presented here harder to establish.

Second, it should be noted that this article focuses on the function of intermediaries in supporting market actors to implement CE, leaving aside the role of civil society. It is recommended to also perform an analysis on the latter role. This will likely lead to the inclusion of an additional function, in which civil society is the key actor.

Finally, the policies and legal frameworks to enhance circular initiatives vary in different parts of the world [2], depending on political systems and governance structure. For instance, China stimulates the circular economy as a top-down national political objective, while countries such as Japan, the USA, and member states of the European Union use the tool of designing bottom-up environmental and waste management policies [1]. It is to be expected that the results of this study are particularly relevant for countries that rely more on multi-stakeholder engagement. Therefore, it is recommended to perform similar case studies on regional governance in the CE transition in other parts of the world. This will allow for a generalisation of the results gained in the study presented here.

Funding: This research received no external funding.

Acknowledgments: I would like to thank Marc Pruijn for his valuable comments on the draft of this paper.

Conflicts of Interest: The author declares no conflict of interest.

References

1. Ghisellini, P.; Cialani, C.; Ulgiati, S. Review on Circular Economy: The Expected Transition to a Balanced Interplay of Environmental and Economic Systems. *J. Clean. Prod.* **2016**, *114*, 11–32. [CrossRef]
2. McDowall, W.; Geng, Y.; Huang, B.; Barteková, E.; Bleischwitz, R.; Türkeli, S.; Kemp, R.; Doménech, T. Circular Economy Policies in China and Europe. *J. Ind. Ecol.* **2017**, *21*, 651–661. [CrossRef]
3. Merli, R.; Preziosi, M.; Acampora, A. How Do Scholars Approach the Circular Economy? A Systematic Literature Review. *J. Clean. Prod.* **2018**, *178*, 703–722. [CrossRef]
4. Winans, K.; Kendall, A.; Deng, H. The History and Current Applications of the CE Concept. *Renew. Sustain. Energy Rev.* **2017**, *68*, 825–833. [CrossRef]
5. Boulding, K.E. The Economics of the Coming *Spaceship Earth*. In *Environmental Quality in a Growing Economy*; Jarrett, H., Ed.; MD Resources for the Future/Johns Hopkins University Press: Baltimore, MD, USA, 1966; pp. 3–14.
6. Ready-Mulvey, G.; Stahel, W.R. *The Potential for Substituting Manpower for Energy: Final Report for the Commission of the European Communities*; Battelle, Geneva Research Centre: Geneva, Switzerland; ECONIS—Online Catalogue of the ZBW: Kiel, Germany, 2017.
7. Murray, A.; Skene, K.; Haynes, K. The Circular Economy: An Interdisciplinary Exploration of the Concept and Application in a Global Context. *J. Bus. Ethics* **2017**, *140*, 369–380. [CrossRef]
8. Ayers, R.U. Industrial Metabolism. In *Technology and Environment*; Ausubel, J.H., Sladovich, H.E., Eds.; National Academy Press: Washington, DC, USA, 1989; pp. 23–49.
9. Frosch, R.A.; Gallopoulos, N.E. Strategies for Manufacturing. *Sci. Am.* **1989**, *189*, 144–152. [CrossRef]
10. Geissdoerfer, M.; Savaget, P.; Bocken, N.; Hultink, E.J. The Circular Economy—A New Sustainability Paradigm? *J. Clean. Prod.* **2017**, *143*, 757–768. [CrossRef]
11. Narodoslawsky, M. Kreislaufwirtschaft -Ein Neues Technologisches und ökologisches Paradima. *VT Newsl.* **1992**, *7*, 23–26.
12. Ellen MacArthur Foundation. *Towards the Circular Economy; Economic and Business Rationale for an Accelerated Transition*; Cowes: Great Britain, UK, 2013; Available online: <https://www.ellenmacarthurfoundation.org> (accessed on 15 May 2020).
13. De Jesus, A.; Antunes, P.; Santos, R.; Mendonça, S. Eco-Innovation in the Transition to a Circular Economy: An Analytical Literature Review. *J. Clean. Prod.* **2016**, *172*, 2999–3018. [CrossRef]
14. Stahel, W.R. The Service Economy: ‘Wealth without Resource Consumption’? *Philos. Trans. R. Soc. A Math. Phys. Eng. Sci.* **1997**, *355*, 1309–1319. [CrossRef]
15. Michelini, G.; Moraes, R.N.; Cunha, R.N.; Costa, J.M.H.; Aldo, R. From Linear to Circular Economy: PSS Conducting the Transition. The 9th CIRP IPSS Conference: Circular Perspectives on Product/Service-Systems. *Procedia CIRP* **2017**, *64*, 2–6. [CrossRef]

16. Lewandowski, M. Designing the Business Models for Circular Economy—Towards the Conceptual Framework. *Sustainability* **2016**, *8*, 43. [\[CrossRef\]](#)
17. Nußholz, J. Circular Business Models: Defining a Concept and Framing an Emerging Research Field. *Sustainability* **2017**, *9*, 1810. [\[CrossRef\]](#)
18. Lahti, T.; Wincent, J.; Parida, V. A Definition and Theoretical Review of the Circular Economy, Value Creation, and Sustainable Business Models: Where Are We Now and Where Should Research Move in the Future? *Sustainability* **2018**, *10*, 2799. [\[CrossRef\]](#)
19. Khitoun, F.; Strozzi, F.; Urbinati, A.; Alberti, F. A Systematic Literature Network Analysis of Existing Themes and Emerging Research Trends in Circular Economy. *Sustainability* **2020**, *12*, 1633. [\[CrossRef\]](#)
20. Pomponi, F.; Moncaster, A. Circular economy for the built environment: A research framework. *J. Clean. Prod.* **2017**, *143*, 710–718. [\[CrossRef\]](#)
21. Kalmykova, Y.; Sadagopan, M.; Rosado, L. CE—From Review of Theories and Practices to Development of Implementation Tools. *Resour. Conserv. Recycl.* **2018**, *135*, 190–201. [\[CrossRef\]](#)
22. Fischer, L.B.; Newig, J. Importance of Actors and Agency in Sustainability Transitions: A Systematic Exploration of the Literature. *Sustainability* **2016**, *8*, 476. [\[CrossRef\]](#)
23. Masi, D.; Day, S.; Godsell, J. Supply Chain Configurations in the Circular Economy: A Systematic Literature Review. *Sustainability* **2017**, *9*, 1602. [\[CrossRef\]](#)
24. Geels, F.W. A Socio-technical Analysis of Low-carbon Transitions; Introducing the Multi-level Perspective into Transport Studies. *Transp. Geogr.* **2012**, *24*, 471–482. [\[CrossRef\]](#)
25. Cramer, J.M. Implementing the Circular Economy in the Amsterdam Metropolitan Area: The interplay between market actors mediated by transition brokers. *Bus. Strategy Environ.* **2020**, in press.
26. Kanda, W.; del Rio, P.; Hjelm, O.; Bienkowska, D. A Technological Innovation Systems approach to Analyse the Roles of Intermediaries in Eco-innovation. *J. Clean. Prod.* **2019**, *227*, 1136–1148. [\[CrossRef\]](#)
27. Kivimaa, P.; Boon, W.; Hyysalo, S.; Klerkx, L. Towards a Typology of Intermediaries in Sustainability Transitions: A Systematic Review and a Research Agenda. *Res. Policy* **2019**, *48*, 1062–1075. [\[CrossRef\]](#)
28. Gliedt, T.; Hoicka, C.E.; Jackson, N. Innovation intermediaries accelerating environmental sustainability Transitions. *J. Clean. Prod.* **2018**, *174*, 1247–1261. [\[CrossRef\]](#)
29. Rotmans, J.; Kemp, R.; van Asselt, M. More Evolution than Revolution: Transition Management in Public Policy. *Foresight* **2001**, *3*, 15–31. [\[CrossRef\]](#)
30. Hekkert, M.P.; Negro, S.O. Functions of innovation systems as a framework to understand sustainable technological change: Empirical evidence for earlier claims. *Technol. Forecast. Soc. Chang.* **2009**, *76*, 584–594. [\[CrossRef\]](#)
31. Van Buren, N.; Demmers, M.; van der Heijden, R.; Witlox, F. Towards a Circular Economy: The Role of Dutch Logistics Industries and Governments. *Sustainability* **2016**, *8*, 647. [\[CrossRef\]](#)
32. Cramer, J. Moving towards a circular economy in the Netherlands: Challenges and directions. In Proceedings of the HKIE Environmental Division Annual Forum, The Future Directions and Breakthroughs of Hong Kong's Environmental Industry, Hong Kong, China, 17 April 2015; HKIE: Hong Kong, China, 2015; pp. 1–9.
33. Ministry of Infrastructure and the Environment; Ministry of Economic Affairs. *A Circular Economy in the Netherlands by 2050: Government-wide Programme for a Circular Economy*; Ministry of Infrastructure and the Environment: The Hague, The Netherlands, 2016.
34. Ministry of Infrastructure and Water Management on Behalf of Other Ministries. *Uitvoeringsprogramma Circulaire Economie (Execution programme Circular Economy) 2019–2023*; Government of the Netherlands: The Hague, The Netherlands, 2019.
35. Seyfang, G.; Haxeltine, A. Growing Grassroots Innovations: Exploring the Role of Community-Based Initiatives in Governing Sustainable Energy Transitions. *Environ. Plan. C Gov. Policy* **2012**, *30*, 381–400. [\[CrossRef\]](#)
36. Markard, J.; Raven, R.; Truffer, B. Sustainability Transitions: An Emerging Field of Research and its Prospects. *Res. Policy* **2012**, *41*, 955–967. [\[CrossRef\]](#)
37. Loorbach, D.; Frantzeskaki, N.; Avelino, F. Sustainability Transitions Research: Transforming Science and Practice for Societal Change. *Annu. Rev. Environ. Resour.* **2017**, *42*, 599–626. [\[CrossRef\]](#)
38. Homrich, A.S.; Galvão, G.; Abadia, L.G.; Carvalho, M.M. The Circular Economy Umbrella: Trends and Gaps on Integrating Pathways. *J. Clean. Prod.* **2018**, *175*, 525–543. [\[CrossRef\]](#)

39. Farla, J.; Markard, J.; Raven, R.; Coenen, L. Sustainability transitions in the making: A closer look at actors, strategies and resources. *Technol. Forecast. Soc. Chang.* **2012**, *79*, 991–998. [\[CrossRef\]](#)
40. Termeer, C.J.A.M.; Dewulf, A. Towards theoretical multiplicity for the governance of transitions: The energy-producing greenhouse case. *Int. J. Sustain. Dev.* **2012**, *15*, 37–53. [\[CrossRef\]](#)
41. Hamann, R.; April, K. On the Role and Capabilities of Collaborative Intermediary Organisations in Urban Sustainability Transitions. *J. Clean. Prod.* **2013**, *50*, 12–21. [\[CrossRef\]](#)
42. Meadowcroft, J. What about the Politics? Sustainable Development, Transition Management, and Long Term Energy Transitions. *Policy Sci.* **2009**, *42*, 323–340. [\[CrossRef\]](#)
43. Avelino, F. *Power in Transition: Empowering Discourses on Sustainability Transitions*; Erasmus University Rotterdam: Rotterdam, The Netherlands, 2011; Available online: <http://hdl.handle.net/1765/30663> (accessed on 15 May 2020).
44. Rauschmayer, F.; Bauler, T.; Schäpke, N. Towards a Thick Understanding of Sustainability Transitions: Linking Transition Management, Capabilities and Social Practices. *Ecol. Econ.* **2015**, *109*, 211–221. [\[CrossRef\]](#)
45. Ritzen, S.; Ölundh Sandström, G. Barriers to the Circular Economy—Integration of Perspectives and Domains. *Procedia CIRP* **2017**, *64*, 7–12. [\[CrossRef\]](#)
46. Kirchherr, J.; Piscicelli, L.; Bour, R.; Kostense-Smit, E.; Muller, J.; Huibrechtse-Truijens, A.; Hekkert, M. Barriers to the Circular Economy: Evidence from the European Union (EU). *Ecol. Econ.* **2018**, *150*, 264–272. [\[CrossRef\]](#)
47. De Römpf, T.J.; Cramer, J.M. How to improve the EU legal framework in view of the circular economy. *J. Energy Nat. Resour. Law* **2020**, in press.
48. Späth, P.; Rohrer, H. Energy regions: The transformative power of regional discourses on socio-technical futures. *Res. Policy* **2010**, *39*, 449–458. [\[CrossRef\]](#)
49. Campbell-Johnston, K.; ten Cate, J.; Elfering-Petrovic, M.; Gupta, J. City Level Circular Transitions: Barriers and Limits in Amsterdam, Utrecht and The Hague. *J. Clean. Prod.* **2014**, *235*, 1232–1239. [\[CrossRef\]](#)
50. Savini, F. The Economy that Runs on Waste: Accumulation in the Circular City. *J. Environ. Policy Plan.* **2019**, *21*, 675–691. [\[CrossRef\]](#)
51. Rip, A.; Kemp, R. Technological change. In *Human Choice and Climate Change*; Rayner, S., Malone, E.J., Eds.; Resources and Technology; Battelle Press: Columbus, OH, USA, 1998; Volume 2, pp. 327–399.
52. Kemp, R.; Schot, J.; Hoogma, R. Regime Shifts to Sustainability Through Processes of Niche Formation: The Approach of Strategic Niche Management. *Technol. Anal. Strateg. Manag.* **1998**, *10*, 175–198. [\[CrossRef\]](#)
53. Schot, J.; Geels, F.W. Strategic Niche Management and Sustainable Innovation Journeys: Theory, Findings, Research Agenda, and Policy. *Technol. Anal. Strateg. Manag.* **2008**, *20*, 537–554. [\[CrossRef\]](#)
54. Van Lente, H.; Hekkert, M.; Smits, R.; van Waveren, B. Roles of Systemic Intermediaries in Transition Processes. *Int. J. Innov. Manag.* **2003**, *7*, 1–33. [\[CrossRef\]](#)
55. Sengers, F.; Wiczorek, A.J.; Raven, R. Experimenting for Sustainability Transitions: A Systematic Literature Review. *Technol. Forecast. Soc. Chang.* **2019**, *145*, 153–164. [\[CrossRef\]](#)
56. Kanda, W.; Clausen, J.; Hjelm, O.; Bienkowska, D. Functions of Intermediaries in Eco-innovation: A Study of Business Development Organizations and Cluster Initiatives in a Swedish and a German Region. In Proceedings of the Presented at the Global Cleaner Production and Sustainable Consumption Conference, Sitges-Barcelona, Spain, 1–4 November 2015.
57. Bush, R.E.; Bale, C.S.E.; Powell, M.; Gouldson, A.; Taylor, P.G.; Gale, W.F. The Role of Intermediaries in Low Carbon Transitions—Empowering Innovations to Unlock District Heating in the UK. *J. Clean. Prod.* **2017**, *148*, 137–147. [\[CrossRef\]](#)
58. Barrie, J.; Zawdie, G.; João, E. Leveraging Triple Helix and System Intermediaries to Enhance Effectiveness of Protected Spaces and Strategic Niche Management for Transitioning to Circular Economy. *Int. J. Technol. Manag. Sustain. Dev.* **2017**, *16*, 25–47. [\[CrossRef\]](#)
59. Carlsson, B.; Stankiewicz, R. On the Nature, Function & Composition of Technological Systems. *J. Evol. Econ.* **1991**, *1*, 93–118.
60. Planko, J.; Cramer, J.M.; Chappin, M.M.H.; Hekkert, M.P. Strategic Collective System Building to Commercialize Sustainability Innovations. *J. Clean. Prod.* **2016**, *112*, 2328–2341. [\[CrossRef\]](#)
61. Cramer, J.M. Practice-based Model for Implementing Circular Economy: The Case of the Amsterdam Metropolitan Area. *J. Clean. Prod.* **2020**, *255*, 1–9. [\[CrossRef\]](#)

62. Cramer, J.M.; van Driel, J.; van Hemel, C.G.; Simons, K.G.V.; Dijkstra, M. *Circulaire Doelenboom als Sturingsinstrument (Circular Target Tree as Steering Instrument)*; Rapport in Opdracht Van de Provincie Utrecht (Report Commissioned by the Province of Utrecht); Utrecht Sustainability Institute: Utrecht, The Netherlands, April 2020.
63. Wittmayer, J.M.; Schäpke, N. Action, Research and Participation: Roles of Researchers in Sustainability Transitions. *Sustain. Sci.* **2014**, *9*, 483–496. [[CrossRef](#)]
64. Hölsgens, R.; Lübke, S.; Hasselkuß, M. Social Innovations in the German Energy Transition: An Attempt to Use the Heuristics of the Multi-Level Perspective of Transitions to Analyze the Diffusion Process of Social Innovation. *Energy Sustain. Soc.* **2018**, *8*, 1–13. [[CrossRef](#)]
65. Van der Heijden, A. Sustainability Embedding Seen Through a Sensemaking Lens; Understanding Engagement Strategies of Change Agents in Companies and Chain Collaboration. Ph.D. Thesis, Utrecht University, Utrecht, The Netherlands, 2018. Available online: www.publicatie-online.nl (accessed on 15 May 2020).
66. Hondeghem, A.; Vandermeulen, F. Competency Management in the Flemish and Dutch Civil Service. *Int. J. Public Sect. Manag.* **2000**, *13*, 342–353. [[CrossRef](#)]
67. Schreuder, Y. The Polder Model in Dutch Economic and Environmental Planning. *Bull. Sci. Technol. Soc.* **2001**, *21*, 237–245. [[CrossRef](#)]



© 2020 by the author. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).